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Energy Aware Routing Algorithms for FI-WI Network: A Survey &Proposal

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ABSTRACT: Fiber-Wireless (Fi-Wi) is a hybrid network with wireless access to provide high bandwidth, cost effective, and internet access. It is integrated form of optimal backend and wireless front-end so that it can support high data rates and throughput with least delay. There are various routing algorithms are available for routing at front end of Fi-Wi network, which are taking care of delay and throughput of the network. None of these are based on energy consumed by the network. So we have proposed to use a simple routing algorithm based on combining minimum distance and minimum angle for routing, which route the data on the basis of energy.. These combined algorithms are called Minimum Angle Minimum Distance (MAMD) and Minimum Distance Minimum Angle (MDMA) algorithms.

KEYWORDS: Fiber Wireless (Fi-Wi), Passive Optical Network (PON), Wireless Mesh Network (WMN), Optical Network Unit (ONU).efficient algorithm;

I. INTRODUCTION

Fiber-Wireless network is a combination of two type of network :

Passive Optical Network (PON) at backend.
Wireless Mesh Network (WMN) at frontend.

PON covers the optical part and it provides high bandwidth capacity to the users at the backend.On the other hand WMN covers the wireless part to provide long distance communication to the end users at the front end.PON can be categorized as TDM PON , WDM PON ,Hybrid TDM/WDM PON and OFDM PON.

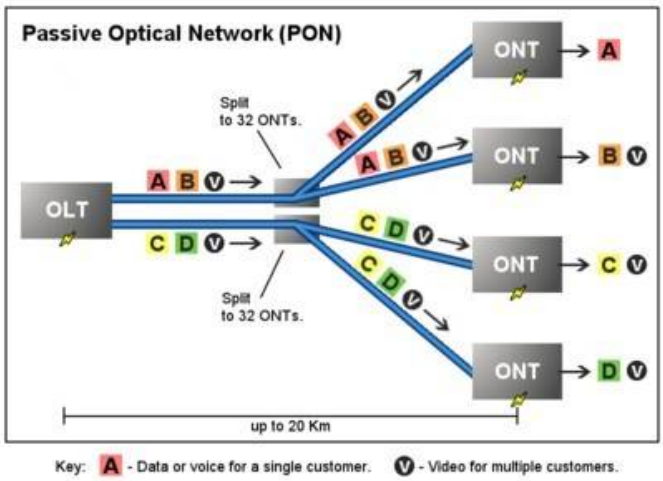

Fig1: Passive Optical Network (PON)

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The dominating optical access technology today is the passive optical network (PON), different PON segments can be supported by a telecom central office (CO),with each PON segment radiating away from the CO.Optical line terminal (OLT) is the head end of the each PON segment,On the other hand the tail end of each PON segment will consist so many optical network unit (ONUs),which provides services to the end users. OLT is located at central office (CO) and remote node (RN) is used to connect different ONUs.Optical signal is converted into wireless and vice versa with the help of ONU.All ONUs are connected to remote node (RN) with the help of feeder fiber while distribution fiber is used to connect the OLT and RN [1].

On the other hand WMN consist wireless gateways, wireless routers and end-users. For connecting the radio nodes in WMN mesh topology is used. If anyone node fails to operate, the path can be established among the rest of the nodes, directly or through one or more intermediate nodes. Usually, gateways are attached with one of the ONUs in the network as we can see from the given figure Uplink and Downlink Transmission of all ONUs are controlled by OLT. An end user sends data packets to a nearby wireless router of the network for uplink communication.

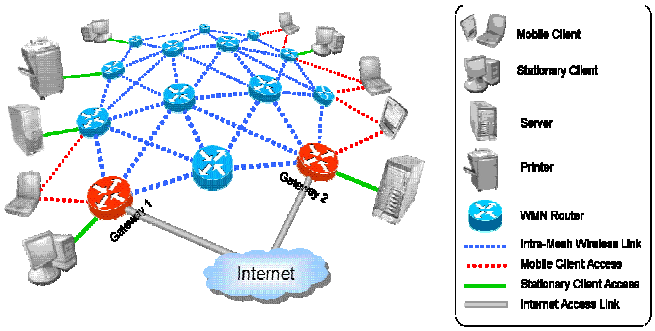

Fig2: Wireless Mesh Network

Similarly, for downlink communication packets travel from OLT through the front-end to the end users. When user need to access internet services the reverse path is followed and packet arrives to the OLT through feeder and distribution fibers and packets get injected into the internet backbone [2].

At the front-end of Fi-Wi the wireless router are used to inject the packets into the wireless mesh of network. The packet travels through the mesh in multiple hops to find one of the ONUs. As the packet travels through several routers in the mesh, packet delay and energy consumption increases as the mesh network becomes large. Packet loss may also occur due to multiple reasons. Thus, to handle these problems proper routing algorithms should be used.

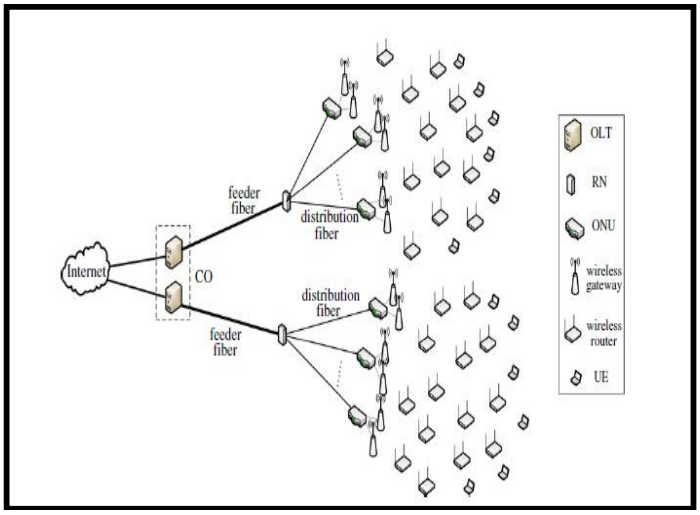

Fig3: Fiber Wireless Access Network

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II. RELATED WORK

Wireless Mesh Network (WMN) is a communication network which contains number of nodes called as wireless mesh nodes. These nodes act as radio transmitters which are analogous to wireless routers. In multihop wireless networks, one or more intermediate nodes present between source and destination. At the front-end of Fi-Wi the wireless router are responsible for injecting the packets into the wireless mesh of network. The packet travels through the mesh in multiple hops to find one of the ONUs and finally sent to wired media with the help of central office (CO).As the packet travels through several routers in the mesh so packet delay and energy consumption are the major problem and it increases as the mesh network becomes large. Packet loss may also occur due to multiple failures. Thus, to handle these problems different algorithms are proposed. Routing in multihop wireless networks is a critical process, it should be carefully considered to maintain the connection between the communicating nodes. Routing protocol is responsible for establishing a communicating link between the source and destination [2].Delay Aware Routing Algorithm (DARA)is used to calculate end to end delay from source router to destination router. It mainly considers four different types of delays i.e. propagation delay, transmission delay, slot synchronization delay and queuing delay [3].DARA helps in achieving load balancing, analyzing link state prediction and measuring throughput.Capacity and Delay Aware Routing Algorithm (CADAR) calculates the end to end delay by assigning the capacities on the basis of link state. Link State Advertisement (LSA) is responsible for advertising the states of all nodes. CADAR gives more accurate results than DARA but it also doesn't focus on energy consumption scenario. [4]. In Risk and Delay Aware Routing Algorithm (RADAR), periodically each router advertises the wireless link state (LSA). LSA is responsible for assigning weights to the links. A Risk List table is maintained on the basis of a path which contains minimum average transfer delay. If failure occurs, RL is updated and packets are sent again [5].

The above implemented algorithms mainly focus on calculating end to end delay, analyzing link state prediction and throughput, but thy don't focus on calculating energy consumption in the network, which is an important parameter of FI-WI network. Moreover these algorithms have complicated mathematical analysis. It can be shown that simple routing algorithm based on energy computation may be attractive solution for routing in FI-WI networks.

III. PROPOSED ALGORITHM

A. *Algorithm*

To compute energy, end to end delay and throughput we propose a different algorithm. A well known simple routing algorithm i.e. Minimum Distance Routing Algorithm is considered for FI-WI network which is based on energy computation. Energy is calculated on the basis of minimum hop count or distance and on the basis of distance, energy is calculated. Another simple joint routing algorithm is called Minimum Angle Routing Algorithm can also used for FI-WI network. In this algorithm when the user wants to send any packet to ONU then first it draws a reference line between ONU and that corresponding router. Now angle is calculated from each router which is in transmission range to the source router with respect to the reference line. Minimum angle is considered and information is sent to that particular node which forms minimum angle. This process is continued till destination is achieved [6].
We can also implement the combine form of Minimum Distance and Minimum Angle Routing Algorithm i.e. Minimum Angle Minimum Distance (MAMD) or Minimum Distance Minimum Angle (MDMA) which depends upon hop count. Hop count can be take any integer value, for example if hop count=2, in case of MAMD, it denotes that two hop count will be measure on the basis of Minimum Angle Algorithm while rest will be on the basis of Minimum Distance Algorithm. Same scenario will be considered in case of MDMA also. If any failures occur then the next minimum angle or minimum distance intermediate node will be calculated. These algorithms help in calculating end to end delay and throughput. Energy is directly related to distance travelled by packets in transmission medium so it can be calculated easily [7].

B. *Discussion and Analysis*

Energy consumed in transmission path depends upon the distance travelled by packets.

$$E_{ij} = Kd^2 \quad \text{..... (1)}$$

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Where k is constant and for simplicity value of k is 1, d denotes distance between nodes i and j. The total energy consumption from source to its particular destination is denoted by:

$$E_p = \sum E_{ij} \quad \text{.....(2)}$$

Where p denotes route and i,j belongs to p. There is a limited power supply for transmission nodes and the transmission energy is directly proportional to the square of the distance between the two nodes. The above equation (1) and (2) are used to calculate energy consumption in transmission medium.

The route with minimum energy consumption is chosen for communication. Energy and throughput are calculated for different values of hop count. As the value of hop count increases, we calculate energy on the basis of distance travelled by packets in transmission ran, as the value of T increases energy consumption decreases and throughput increases. Thus in the same network scenario by varying the hop count we can optimize energy, end to end delay and throughput [7].The proposed work can be simulated using a suitable network simulator.

IV. CONCLUSION AND FUTURE WORK

Fi-Wi is the combination of high capacity of passive optical network with mobile wireless network creates a perfect platform for all future application and networking services. To summarize the overall contribution of this proposed work different algorithms are discussed which helps in calculate delay and throughput parameters. Minimum Angle Minimum Distance (MAMD) and Minimum Distance Minimum Angle (MDMA), these two algorithms are suggested to be used for routing whichare based on hop count. The characteristic of proposed algorithm is that we can easily compute the energy consumption in the networkalong with throughput and end to end delay of traditional algorithms. The proposed work can be simulated using a suitable network simulator.

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